

# SCIENCE :

## A WEEKLY RECORD OF SCIENTIFIC PROGRESS.

JOHN MICHELS, Editor.

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SATURDAY, DECEMBER 17, 1881.

In an official report of the proceedings of the New York Academy of Sciences, to be found in another column of this issue, Commander Cheyne explains in detail, his proposition for reaching the North Pole in conjunction with Lieut. Schwatka, by means of balloons.

It must be conceded that the project involves great difficulties and dangers, but perhaps not greater than those to be encountered by the ordinary methods, and as new elements of success are made probable, we desire to have the scheme thoroughly discussed on its merits.

The most practical course for Commander Cheyne to adopt, would be to immediately form a committee of Arctic experts, and those who have identified themselves with such projects, when the practicability of his scheme can be affirmed or condemned. Commander Cheyne informs us that he desires the formation of such a committee, and that his plans shall be thoroughly investigated. We, therefore, invite those who are interested in the success of this expedition, to at once signify their intention to co-operate.

Those who have suggestions to make, and can speak from experience, either on the subject of Arctic travel or aeronautic tactics, are invited to express their views.

Commander Cheyne frequently visits our office, and will no doubt attend to any appointment to meet those desiring a personal interview.

THE evidence of Dr. Ed. C. Spitzka, at the Guiteau trial, is still incomplete at the date of our writing and we reserve to a later date a full expression of our opinion upon the direct bearing of his evidence on the degree of insanity of the prisoner.

The prosecution appear to have made a mistake in endeavoring to assail the professional character of the

witness (which is unimpeachable), instead of closely analyzing the evidence he offered.

No more conscientious and intelligent witness than Dr. Spitzka can enter a witness-box, or one better qualified from experience and study to offer an opinion on the question of insanity; but we shall show that the little band of professed alienists, in dealing with their subject, may be compared to men who have just arrived in a new and partly surveyed territory; roads have been constructed, but where they lead to none can tell; land is reached on which it is dangerous to tread; the ground work of the plan has yet to be sketched, and the wealth beneath the surface has never been probed. The fact is, that the science of the modern alienist is still in embryo, and even its nomenclature undetermined, the facts so far discovered by continental alienists and anatomists, and by such men as Hammond, Wilder, Clevenger and Spitzka in our country, are important and interesting, but they are as yet but the pebbles with which the fabric of the science must be constructed.

Between perfect sanity and insanity there is an immense scale of gradation, and the fact that Dr. Spitzka classifies both Dr. Samuel Johnson and Guiteau under the one head of monomaniacs, shows how wide a range the subject covers, and how subtle are the distinctions to be made.

OF all the numerous topics which are the common field of the physician and the biologist, none is of as great interest, both in its practical bearings and intrinsically, as a fascinating theme, as that of the location of mental faculties in the brain. Year by year scientific inquiry is narrowing down the question of the existence of the mind into the functional realm of those great masses of nerve tissue, which, filling out the cavity of the skull, have already formed an empirical and unconscious recognition by the ancients when they endowed the Goddess Minerva with a higher brow than Venus, and Apollo with a greater facial angle than Bacchus.

For a long time observers contented themselves with mere measurement of the volume of the brain; a heavy brain was supposed to be capable of higher mental action than a light brain; the elephant and the whale were contrasted with the alligator and tortoise, and after bitter contests waged in scientific societies, the conclusion was arrived at that only animals approaching each other in size, as well as in zoological position, should be compared to obtain data. The original proposition is sustained by the fact that in weight proportionate to that of the body the elephant exceeds the hippopotamus—the dog, the fox—the chimpanzee, the baboon; the marmoset, the

squirrel—the rabbit, the kangaroo—and so on through the list. The intellectual standard finds its expression in a greater brain-weight among animals.

Any one who has glanced at the older anatomical atlanti will have been struck by the picturesque folds and festoons into which the brain-surface is thrown. He may compare the folds in the representations of different authors and will arrive at the conclusion that they can have no definite importance, because they differ so absolutely in every diagram examined.

The fact is that these folds or corrugations, familiarly known as the CONVOLUTIONS of the brain, were later recognized to be very methodically and regularly arranged, and to follow a distinct plan for each zoological species, including man. The old anatomical masters, ignorant of this fact, allowed their draughtsmen to fill in the details according to their fancies, and these naturally led the latter to pay more attention to the picturesque than the true. Now the contest as to the location of mind in the brain took another form, the opponents of the materialistic theory, that brain and soul are united, tacitly admitted the general proposition, and orthodox anatomists endeavored to discover as numerous and as decisive criteria by which to distinguish the brain of man from that of the ape as diligent research could unearth. But one barrier after another which they erected has been swept away by their opponents. Owen's claim that the apes had no lesser hippocamp, was demolished by Huxley, the Island of Reil has been demonstrated in animals far below the monkey tribe, the cerebral overlap is recognized to be decided in the anthropoids and in other monkeys as in many human subjects, and even an indication of an opercular formation has been found in defective human brains, while the last criterion, the alleged absence of the "*Zwickelwindung*" in man, has been demonstrated to be faulty by Parker, of Philadelphia.

The great similarity of the chief surface features of the monkey's brain with those of the human, led Ferrier and Munk after preliminary experiment by Hitzig and themselves to attempt the isolation of willed muscular movements, and of special sensory perception in the cerebral convolutions of the monkey. The researches of Meynert had shown that anatomically the brain "bark" or "rind" [*cortex cerebri*] occupied the position of a mirror as it were, on whose inner face about the photophone wires represented by nerve bundles, transmitting the messages from the outer world. Meynert found that the nerve fibres from the eye, the skin in general, the ear, the nose, and tongue, went to special convolutions, and that to other convolutions went fibres which controlled muscular movements. Now the experiments of Munk and Ferrier confirm the anatomical premise of Meynert, in its general bearings.

They found by cutting away a given part of the brain, blindness would result, the removal of another part would be followed by deafness, of still another by paralysis. They and others also established that if those parts whose removal was known to be followed by paralysis, were instead of being injured, stimulated (by electricity) special motions could be produced at will. In other words, these investigators found the keys of the mind before them in the convolutions of the brain, and by touching a special key, were enabled to forge the will signature of the animal, as it were. Special parts of the human brain, when the seat of disease or of injuries, are shown to have similar functions. A man has an apoplectic stroke, or an abscess, or a softening, or a tumor of the brain. If that disturbance is in one part he may be blind in a portion of his visual field, or he may lose the memory of words, or their articulation, or the ability to write, or he may be paralyzed in one arm, or one leg, or only on one side of his face. If the disturbance is extensive, several of these symptoms co-exist. It is noteworthy that these disease experiments, if we may so term them, confirm the physiological experiments made on monkeys in a remarkable manner, and it seems that the great problem of the relation between brain and mind is nearing a solution through different channels of research, approaching the same goal.

#### NEW YORK ACADEMY OF SCIENCES.

November 28, 1881.

#### LECTURE EVENING.

The President, Dr. J. S. NEWBERRY, in the Chair.  
The hall was filled to overflowing.

In introducing the lecturer of the evening, the President stated:

"Captain Cheyne asks you to examine his plans carefully. He has been with three expeditions to the Arctic regions, and has spent there five and a half years. He has been there under so many circumstances that he knows, perhaps better than any other man, the difficulties to be encountered and how to overcome them. He comes recommended by the highest authorities in England. His plan is not chimerical, and it is certainly heroic. Men will yet surely go to the Pole, if they have to crawl there on their hands and knees; and an enterprise of this kind is worthy of attention in these days, if only to withdraw the minds of men from their shops and money-getting and purely selfish occupations."

COMMANDER JOHN P. CHEYNE, R. N., F. R. G. S., then delivered the following lecture:

#### THE DISCOVERY OF THE NORTH POLE PRACTICABLE. (Abstract.)

Reference was first made to the large number of local committees—sixty-two—and of influential persons in England who have signified their approval of this enterprise.

A Council has been formed in England and is now awaiting the news from America. As soon as it is heard of action taken here toward the formation of an Anglo-American expedition, the members of the Council

will bestir themselves. It was originally designed, by means of an expedition, the cost of which would have been about £30,000, to include the circumnavigation of Greenland, besides the journey to the North Pole.

The lecturer then considered the probable position now occupied by the "Jeannette," under the command of Lieut. De Long. His opinion was that this vessel is somewhere to the northward of Grinnell Land, and it was based on the presumption of a circumpolar current flowing towards the east along the American continent, carrying the "Jeannette" from Behrings Straits towards Greenland, and not along the Siberian coast, as some have supposed. The great body of warm water that flows northward by the peninsula of Norway and Sweden strikes the lighter currents near the Pole and goes on as a submarine current, sweeping around the Pole till it goes out again through Smith's Sound. This current would naturally carry the "Jeannette," as she goes towards the Pole, in the direction of Smith's Sound. Hence Commander Cheyne proposes to search for her by proceeding up Baffin's Bay and Smith's Sound as far as the coal mine near Discovery Harbor. Not very far from this vicinity he expects to find the missing vessel, if she has not already reached the North Pole. The "Jeannette" has been only two years absent, and it is time enough to expect her next October or November. There is as yet no occasion for anxiety as to her safety, nor will be for a year to come.

The following plan is proposed for reaching the Pole: a small vessel will be engaged to convey the exploring party, with provisions for two years and a half, to St. Patrick's Bay, near Discovery Harbor, leave them there, and immediately return. The party will consist of seventeen persons all told, including Lieut. Schwatka, U. S. A., the commander of the late American Franklin search expedition, who has most cordially volunteered to accompany this party on the part of America.

To attempt to reach the Pole in the usual manner, there would be required six sledging parties of five men each. Each man would have to drag 215 pounds. The Lecturer believed that the journey could be performed by means of sledges, as he had not the most remote idea that there is an open sea about the Pole. Starting in April or early May with the six sledges, they would go fifty or sixty miles on the journey; and then sledge No. 6 would stop and bury in some safe place all its spare supplies as a depot for the return journey, and that sledge would return to the ship. After going fifty or sixty miles more the fifth sledge would stop in the same way, bury its spare provisions, and return to the ship. The first sledge would keep on until the Pole was reached. In this way the journey might be made in 106 days, but would be far more difficult and laborious than that proposed by the following plan:

On arrival at St. Patrick's Bay three snow observatories will be established, one situated in the immediate vicinity of the coal mine, at St. Patrick's Bay, another fifty miles further north, and the third the same distance to the south. These observatories will be connected by telegraph wires, and hourly meteorological observations will be taken and transmitted to the central station. Thus accurate information as to the direction and force of the wind simultaneously over a distance of one hundred miles will be obtained and immediately plotted at the central station. When the proper wind curve for reaching the Pole is found to exist, the attempt will be made by means of balloons. These will be of large size, and three in number, costing altogether, about £12,000. Each will carry three men, be provided with a boat car, a set of Esquimaux dogs, and provisions for fifty-one days. The total load for each balloon will be between one and one-half and two tons. The gas for inflating the balloons will be generated, at least mainly, from the abundant coal at this harbor, and to prevent the too rapid diffusion and loss of gas, it is proposed to employ a double

envelope of silk with an intermediate layer of gold-beaters' skin. It has not yet been decided whether to use pure hydrogen or a mixture of coal gas and hydrogen. The Commander has convinced himself by experiments with balloons, both in polar regions and in England, that they can be satisfactorily used in the way above proposed; and he hopes to cover the distance from St. Patrick's Bay to the Pole, 496 miles, in from eighteen to twenty-four hours. The altitude of the balloons will be regulated at about one thousand feet by means of a trail rope. After arrival at the Pole, advantage will be taken of a favorable wind to return to St. Patrick's Bay, or, possibly, to continue in one balloon right on to some part of Russia, should it appear better to take that course. Any loss of gas during the balloon trip, which may be found to have occasioned a deficiency on arrival at the Pole, or during a short stay there for scientific observations, may be remedied by the abandonment of one balloon and the transference of its gas into the other two and possibly, by the conveyance of a small supply of hydrogen in steel cylinders.

Many interesting arctic phenomena were discussed: *e. g.*, the proofs that the aurora borealis was not caused by atmospheric electricity but by magnetism: the numerous parhelia and mock moons visible in polar regions: the mode of formation of glaciers and icebergs, and the curious shapes assumed by the latter.

The coal of the mine at St. Patrick's Bay was described as equal to the best Welsh, almost smokeless, and existing in very large quantities. The present meagre flora of Greenland was compared with the rich ancient flora, almost tropical in character, shown by the fossil plants found in the Tertiary beds of the vicinity of Disco. More than fifty species of trees and shrubs have been obtained from these deposits.

In conclusion the Lecturer spoke of the very probable success of the proposed Anglo-American expedition now being organized by Lieut. Schwatka and himself, and stated that the estimated expense, at a minimum, is to be £16,000, each country to provide half of this sum, and all discoveries to be equally shared by the two nations. The Commander laid great stress upon the good feeling existing between America and England, expressing the opinion that the organization of such a joint expedition as proposed, especially if the two national flags were to be planted side by side at the world's apex, would so materially develop that feeling, that therein would be at once an answer to those questioners who asked "*cui bono?*" What commercial return can we expect for our expenditure for equipment?" Further utilitarian achievements were then touched upon, as relating to the more thorough study of the sea-bottom by soundings, and of the oceanic currents within the Arctic circle, so that in time commerce will be enabled to work out more definite highways for the passage of ships across the ocean; also to the development of knowledge in different branches of science, in addition to the advantages that might accrue in opening up and investigating such a vast unknown area.

At the conclusion of the lecture, the audience expressed, by a show of hands, its hearty interest in the subject, after the delightful mode of its presentation and illustration by Commander Cheyne, and its recommendation of the matter to the careful consideration of the public.

ELECTROLYSIS OF WATER.—D. Tommassi.—According to the author a zinc-copper or zinc-carbon element plunged into dilute sulphuric acid does not decompose water if the two electrodes are of platinum. In order that the electrolysis of water may take place, the positive electrode must be formed of a metal which, under the influence of the voltaic current is able to combine with the water.—(*Comptes Rendus Oct.*, 24, 1881.)

# AN EXPERIMENT UPON ELECTRIC FISH MADE BY GALVANI.\*

Translated from the *Revue Scientifique* by the Marchioness  
CLARA LANZA.

Among the objects which are to be found in the *Musée Retrospectif*, is a little note book that once belonged to Louis Galvani. This note book, which has been kindly placed at our disposal by the Chevalier Auguste Mattioli, a great nephew of Galvani, contains autographic notes made by the illustrious forerunner of Volta, relative to some experiments performed upon torpedos in the year 1795, during a voyage to Sinigalia and Rimini, taken expressly by Galvani that he might study electric fish.

We find the following dates in the note book, 14th, 16th, and 17th of May, relating probably to Sinigalia, and that of the 19th of May to Rimini, where Galvani remained but two days.

The facts and considerations registered in the note book are partially to be found also in the fifth memoir addressed by Galvani to Spallanzani. But the whole has not been produced heretofore, and it will be a matter of some interest doubtless to learn that the autographic notes of Galvani contain passages which show us that in all probability he was the first to make observations relative to electric *polarization*. He would, perhaps, have carried the study further had not death interrupted his career on the 14th of December, 1798, when he was but sixty-one years of age.

The unpublished manuscript which I am going to produce does not detract from the merits of Gautherot, Ritter or any other *savants* who have given particular attention to the phenomena called by de la Rue *electric polarization*. It is no less interesting and curious, however, to be able to affirm that Galvani had observed them and distinguished them from other phenomena, four years before the pile was discovered.

In order to fully understand what I shall translate to you, it must be borne in mind that to Galvani muscular fibre represented a Leyden jar into which the nerve thread entered that played the rôle of conductor for the interior armor of the jar, while the exterior surface of the muscular fibre represented the outer armor of the small condenser. This hypothesis is advanced in Galvani's memoir entitled, *De viribus electricitatis in motu musculari, commentarium*, printed in Bologna, 1781.

Here now are the notes: no. 1, page 22.

"May 14-16, 1795.

"After a prepared frog has undergone several contractions upon the torpedo, if it is held by the feet with one hand, while a finger of the other hand is applied to its nerves, new contractions occur successively whenever the finger is separated from the nerves—that is to say, whenever the arc is interrupted.

"As I had made quantities of experiments in the ordinary manner without witnessing anything of the kind, I thought that in this case electricity was communicated from the torpedo to the frog, and had charged the little Leyden jars which I supposed were there."

No. 2, page 68.

"May 19, 1795.

"In operating upon two prepared frogs, whose nerves were detached from the spinal marrow, it happened that after they had been applied to the torpedo's back, and experienced several successive convulsions, particularly from shocks given directly by the torpedo, they contracted habitually when they were held by the feet with two fingers of one hand, or by a silken thread, while their nerves were touched by the fingers of the other hand, moistened by contact with the torpedo. The convulsions took place each time that the nerves ceased to be touched by the fingers, that is, whenever I interrupted the arc formed

by the two arms and the corresponding part of the thorax, which arc was applied at one end to the frog's feet and at the other to its nerves.

"This phenomenon lasted for some time and appeared more pronounced in the frog which had become convulsed by being applied merely to the torpedo's back without receiving any shock whatever.

"Once exhausted the phenomenon did not repeat itself, probably because the electricity from the torpedo having entered the nerves had weakened the muscular power of contraction.

"I have often used the same arc while experimenting upon numbers of frogs, but never before observed so many contractions produced so rapidly. It would not be unreasonable therefore, to suppose, that in this case the torpedo transmits a portion of its electricity to the frog and charges the little animal Leyden jars which exist in my imagination.

"It might perhaps be discharged again, produce a fresh charge and give rise to other contractions. The first supposition however, appears more probable.

"Whichever it may be, the entire modification occurs in the frog and not in the fingers or the hand which touch the torpedo. For having moistened the back of the hand which certainly did not come in contact with the torpedo, the result, on repeating the experiment, was precisely the same."

If I am not seriously mistaken, we have here actual phenomena of polarization provoked by the rapidity of the discharges from the torpedo (direct or indirect) across the nerves or muscles of the prepared frogs. The first observation of these facts is due to Galvani, although he employed no other instruments than these same frogs which had already made him familiar with the phenomena attributed to Volta to the contact of metals, and from which was soon to arise that wonderful apparatus called the Pile, whose marvellous development has been fully attested.<sup>1</sup>

## AN IMPORTANT CONTRIBUTION TO THE DOCTRINE OF CEREBRAL LOCALIZATION.

BY E. C. SPITZKA, M. D.

With the collapse of phrenology, an undue reaction set in against all attempts to undue functions in the convolutions of the human brain. The important anatomical theorization of Meynert, who taught that while the anterior zones of the brain were rather motor, the posterior and temporal lobes rather sensory in character, opened the path to the experimental inquiries of Hitzig who demonstrated the former truth by means of localized electrization in dogs, and thus suggested a rational distribution of simple functions in the organ of the intelligence, in no respect however comparable to the erroneous schematizations of Gall. The most recent and important contribution to this subject is entitled:

UNTERSUCHUNGEN UBER DIE LOCALIZATION DER FUNCTIONEN IN DER GROSSHIRNRINDE DES MENSCHEN, by Prof. Sigmund Exner, of Vienna.

<sup>1</sup> M. du Bois Reymond made a few remark upon the notes read by M. Govi. He wished to call attention to the fact that Galvani's experiments, although very interesting in themselves, are far from procuring a polarization in the actual sense of the word. All that really occurred was this: the frogs that gave no shock without metal, produced one after being exposed to the torpedo's discharges. This phenomenon could not be assimilated to polarization, that is to the production of secondary properties in the conductors by the fact of a primary current traversing these conductors. M. du Bois Reymond does not pretend to explain definitely the phenomena observed by Galvani. It is probable however that the frog's greatest sensibility to its own current was simply the effect of the immersion of the muscles and nerves in the sea water and mucus upon the torpedo's body. By this immersion the tendinous extremities of the gastrocnemius and the exterior of the femur would acquire the negativeness which belongs to them in a state of mechanical or chemical transverse section. That is, the muscular current would be increased in intensity. This according to M. du Bois Reymond, is the most probable explanation of the phenomenon mentioned in Galvani's note-book.

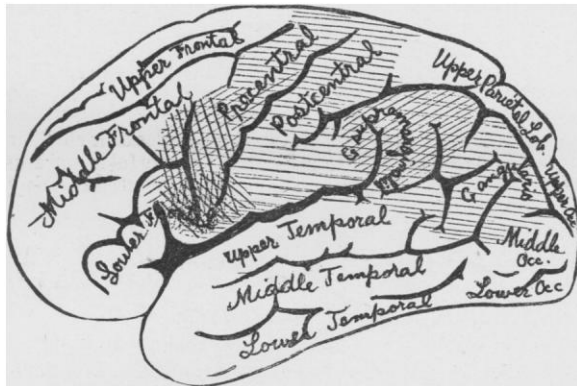
\*This communication was made by M. Govi before the Congress of Electricians, October 5, 1881.

This monograph constitutes an important *etappe* in our progress to a definite and reliable localization of the functions mediated through the cerebral cortex. Its author believing that the time has come for collating the numerous registered cases of circumscribed cortical lesions, has, in place of performing new experiments in this well-trodden field, contented himself with endeavoring to harmonize the often times conflicting observations of others, and at the same time sifted the wheat from the chaff. Over a thousand cases were collected by him, and of these a hundred and sixty-nine positive observations were found to comply with all the demands which a critical investigator would be apt to make.

Professor Exner has approached the difficult subject of which his work treats, by three different lines of research. The first follows the "method by negative cases," the second, "the method by percentage calculation," and the third "the method by positive cases." The latter method he considers the least reliable. The first method consists in marking on a diagram of a hemisphere, all those cases in which a cortical lesion occurred without producing a given disturbance, and inferring from this the presumable area within which the undisturbed function resides. With the second method, the area of a brain cast is subdivided by arbitrary lines into a number of squares. Of these the author made three hundred and sixty-seven, the smallest and most numerous being at the more important regions, such as the neighborhood of the Rolandic, and

a pitch-black color would designate the field with which paralysis of the arm was a constant symptom, less darker shades those in which it occurred in eighty, sixty and forty per cent. of the cases recorded, and very light shades for those with whose lesions, paralysis occurred in a still smaller percentage. This method proved of great value, inasmuch as it enabled the investigator to discriminate between what he happily terms the *absolute* and the *relative* cortical fields, the former being those whose lesions invariably produce a given phenomenon, the latter those whose lesions frequently, but not as constantly, produce the same result.

The third method is considered admissible only on the condition that not only a given prominent disturbance be marked down to a special field, with whose lesion it occurs, but that also all accompanying anomalies be registered with it. The site of a given centre can then be inferred, from the greatest accumulation of special foci. The reason why Exner considers this method as the most uncertain he illustrates by the following suppositious case. "Let us take for granted that the part of the *Gyrus fornicatus* adjoining the paracentral lobule, is the cortical field for the lower extremity. The part mentioned is but extremely rarely the seat of disease (there is but one case in my series, in which it was affected), the latter occurrence on the other hand is very frequent. Now, disease of the paracentral lobule, will, as can be inferred from other cases, also exert a

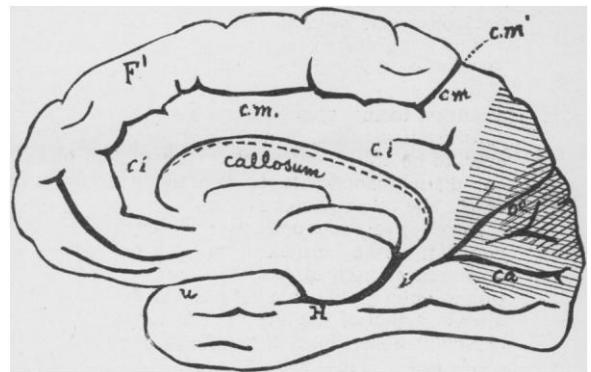


a. Diagram showing the cases of cortical lesion producing tongue-paralysis, left hemisphere.

Occipito-Parietal sulci. He then constructed tables, in which each of the arbitrary fields occupied a place, designated by its numeral, while in one column, the side of the hemisphere, in another the number of cases in which the field was involved, and in others the percentage of these cases, in which a given disturbance occurred are registered. For example, the record of "field 53" which is at the junction of the upper and middle thirds of the precentral gyrus and bordering the central fissure, reads as follows:

| C               | No. of Cases. | Facial Muscles. | Upper Extremity. | Lower Extremity. | Speech. | Muscles of Neck. | Muscles of Tongue. | Muscles of Eye-ball. | Tactile Disturbance. | Visual Disturbance. | No Disturbance. |
|-----------------|---------------|-----------------|------------------|------------------|---------|------------------|--------------------|----------------------|----------------------|---------------------|-----------------|
| On right side.  | 8             | .88             | .100             | .63              | ..      | .13              | .13                | .13                  | .13                  | .13                 | .00             |
| On left side .. | 22            | .76             | .100             | .73              | .14     | .09              | .14                | .09                  | .09                  | .00                 | .00             |

Based on these tables Exner painted the squares on different casts or diagrams, with a dark color whose intensity decreased with the lesser constancy of the symptoms referable to that field. Thus on a given diagram,

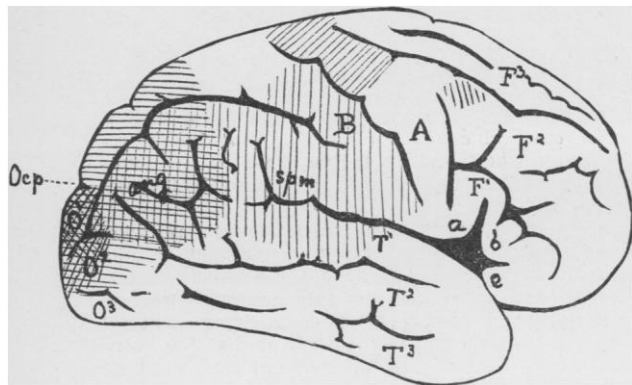


c. Same field on mesal face of right hemisphere.

disturbing influence on the neighboring gyrus. We will then register several, perhaps even many cases, in which injuries of the paracentral lobule are accompanied by disturbances of motility of the lower extremity, and from this conclude that the cortical field for the latter is in that lobule." He strongly protests against the unjustifiable assumption of narrow cortical centres on the basis of one or two isolated lesions, while ignoring the other symptoms co-existent with the one which is referred to that centre. An example of such an assumption is that by Landoosy who claimed on the basis of some (admittedly striking) cases, that the cortical field of the levator palpebræ was in the posterior part of the inferior parietal lobule. He endorses the criticisms of Nothnagel, but does not go to the extent of claiming as the latter does, that in order to justify the localization of a centre, the symptoms referred to it in a given case should be of chronic stability. He maintains that they may be evanescent, on the basis of the evanescent nature of the symptoms produced by cortical excision in dogs, and notably on the strength of the celebrated case recorded by Hitzig, of a dog in whom the removal of a cortical field, which just previously had been determined by electrization to innervate the anterior extremity, failed to produce paralysis, then showed paralysis on an additional incision at the operated region being made, from which he recovered after some weeks.

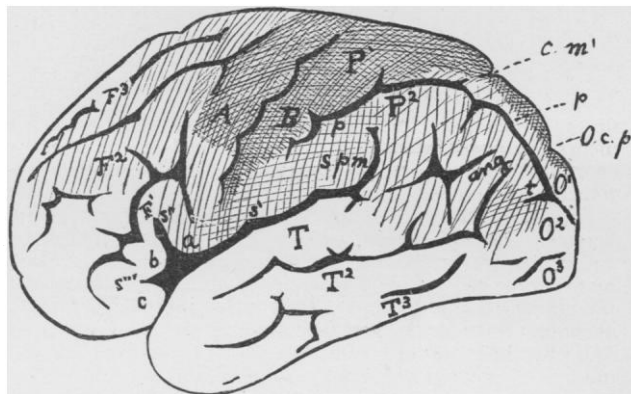
The author, after these provisional remarks, and a more detailed statement of his manner of marking the lesions, than could be properly recapitulated within the limits of this review, proceeds to describe what he terms the "cortical area of latent lesions" that is, the large area which *may* be the seat of a lesion without the occurrence of any motor or sensory disturbance. Remarkably enough this area is larger on the right hemisphere than on the left, a fact attributed by Exner, to the greater extent of the motor fields on the left side; aside from this, the respective areas, are, as might be anticipated, symmetrical. In the area of "latent lesions" there are degrees of latency, just as there are "absolute" and "relative" fields in the active fields, and while Exner includes all areas in which motor and sensory disturbances are not *necessary* results of lesions, under the designation latent, he does not intend to convey the impression that such symptoms may not be produced there. In this limited sense, the entire right hemisphere is latent, with the exception of the precentral and post-central gyri, the para-central lobule, and a strip of the convex surface as well as the ventral surface of the occipital lobe. Probably the latent area of the right frontal lobe would have turned out to be more limited, had Exner not included the case of an imbecile, in whom a lesion of the posterior ends of the three frontal gyri of the right side, failed to produce any paralysis or disturbances of sensation, "in the ordinary sense of the term." On the left hemisphere the latent fields occupy the cortical sur-

dratus, with possibly part of the cuneus. On comparing the area just mentioned with the other cortical fields derived from his studies, Exner comes to the conclusion that the field of the right arm is the largest of all the cortical areas. The absolute field of the posterior extremity on the right hemisphere consists of the para-central lobule, the upper third of the precentral, a lesser portion of the adjoining part of the post-central gyrus, and a few spots behind and below the lobulus quadratus. On the left hemisphere, it is very similar in extent, but includes in addition the greater part of the upper parietal lobule. Instead of occupying an insignificant portion of the post-central gyrus, it encroaches on the whole upper half, and is less marked on the precentral. In fact there is a general tendency of the left hemisphere field of the extremities to extend backwards as contrasted with the corresponding right field. Exner adds that if his tables could have been so compiled, as to show at a glance the extent of each of the lesions producing paralysis of the extremities, the greater "sensitiveness" of the field for the upper extremity as contrasted with that of the lower would have become evident. In other words, lesions of slight extent involving those areas common to both extremities, will frequently produce paralysis of the arm alone, while the leg is unaffected. The cortical field of the facial muscles is an absolute one only on the left hemisphere; it is merely relative on the right side, where it attains the greatest intensity, about  $\frac{1}{10}$  in the lower third of the post-



δ Diagram of cases producing visual disturbance, convexity of right hemisphere.

face with the additional exception of the entire parietal and a greater portion of the occipital lobe. This encroachment on the latent field is due to the great development of the visual field and the greater posterior extension of the motor fields. The position of the gyrus fornicatus is in part very doubtful on account of the rarity of lesions of this locality. The cortical field for the right upper extremity consists of the para-central lobule, the precentral gyrus, with the exception of its lower-most portions, and the upper half of the post-central gyrus; it is an open question whether the anterior part of the lobulus quadratus, and a part of the gyrus fornicatus, may not have the same relation. The region indicated is an "absolute" cortical field, that is, it was thus far never found the seat of a lesion, when paralysis of the left arm was absent. Surrounding this area, there is a considerable "relative" field which extends over nearly the entire hemisphere. The absolute cortical field for the right upper extremity, that is the one of the left cerebral hemisphere, is larger, it includes the greater part of the upper parietal lobule, the upper two thirds of each of the central gyri, the para-central lobule, and very likely a part of the inner face of the occipital lobe. The relative field of "great intensity" occupies the posterior half of the upper frontal, nearly the whole of the middle and inferior frontals on the convexity, the upper part of the occipital lobe, and the lobulus qua-



α Field of the upper extremity on convexity of left hemisphere.

central, and the lower half of the precentral gyrus, shading off to the posterior part of the middle and lower frontals, and the anterior part of the supermarginal gyrus. The left absolute field is a narrow streak belonging to the anterior part of the precentral gyrus opposite the end of the middle frontal, the relative field is symmetrical with that of the right side, the same tendency to a more posterior encroachment noticed in the case of the extremity fields, characterizes the left facial field. In the facial field, Exner found it impossible to differentiate the different muscular groups beyond the confirmation of the old observation that the palpebral orbicularis is only exceptionally disturbed by any cortical lesion.

The hypoglossal field is very difficult to establish; it appears to be relative on both hemispheres, nowhere exceeding  $\frac{1}{10}$ ; it is remarkable that this field is less intense on the left hemisphere than on the right. This fact, Exner endeavors, in our opinion, very plausibly to explain on the basis of Stricker's metaphor. Stricker compared the muscles of articulation to a well trained pair of carriage horses, driven with double reins, by two drivers, (the cortical centers of each side) in such a way that while both drivers or the right one alone directed them in their ordinary gait, the left one alone was capable of directing their finer evolutions. If we bear in mind that as far as the coarser movements are concerned, each driver chiefly watches the opposite horse, but the left one



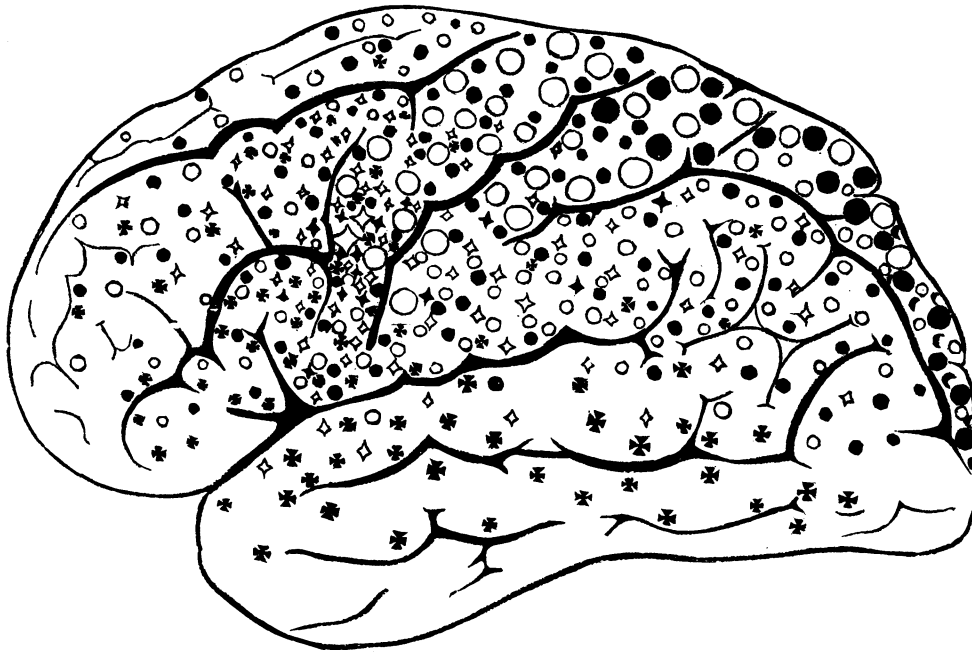


Diagram showing all the ascertained special functional fields on the convexity of the left hemisphere. The large-sized symbols indicate the "absolute" fields, the smaller ones the "relative" fields.  
 Upper extremity, represented by light circles. Speech represented by crosses.  
 Lower " " " " dark circles. Tongue muscles represented by dark rhombs.  
 Vision " " " " crescents. Facial " " " " light rhombs.

on the whole, pays least attention to these very movements, the lesser intensity of a field devoted to the finer coordinations becomes less contradictory with our theoretical conceptions.

Exner encountered some difficulty in discriminating between the areas responsible for different forms of speech disturbance, owing to the imperfect description of many of the cases registered. In general, it seems that the nearer a lesion of the symbolic field approaches the absolute center for the arm, the more likely is agraphia to occur, the more the middle temporal is involved, the more likely is word deafness. Amnesic aphasia appears to be more dependent on generalized lesion, and the probability of pure ataxic aphasia increases with the approach of the lesion to the posterior end (pars opercularis) of the lower frontal gyrus, and the limitation of the destructive lesion.

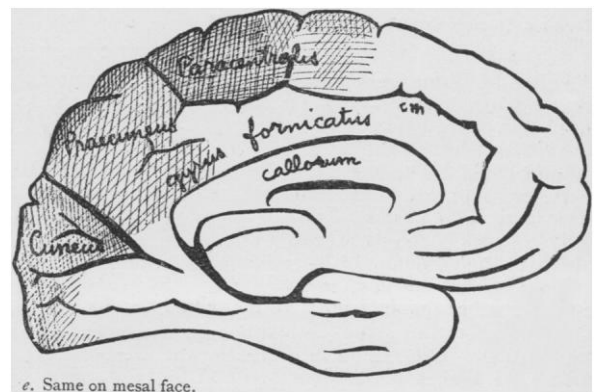
As regards the visual field, Exner's tables confirm Muhr and constitute a crushing *dementi* for Ferrier. Truly the whirligig of time has brought about its revenges in this instance. The only comment Ferrier had to make about the philosophical and painstaking researches of Muhr, consisted in a sneer at their unreliability. Now Muhr's observations have stood the test of clinical experience as well as of anatomical research, and Ferrier's alleged results are relegated to the domain of the fanciful and "not proven."

The field of the tactile sensations is much more intense on the right than on the left hemisphere, and there appears to exist a sort of complimentary relation between the two hemispheres, the left preponderating over the right as regards motility, the right over the left as regards sensation. As it is highly probable that the visceral innervations follow the visceral sensations and these general sensations in the cortical fieldings, this discovery of Exner's may open the door to a confirmation of the view advanced by Brown-Sequard and others, that right sided lesions are more apt to involve the organic functions and are hence of greater fatality than those of the left side.

As a rule the sensory fields are nearly identical with

the motor fields for the same periphery, and the author cites as a remarkable corroboration, the experimental results of Munk, who found his tactile areas in the dog's brain to almost correspond with the motor areas discovered by Hitzig.

As the most important result following from Exner's work, we must point to the beautiful explanation it furnishes of the why and wherefore of the so-called vicarious areas of the cortex, and the satisfactory manner in which it disposes of the objections of Goltz and Brown-Sequard. If we fully imbibe the doctrine that the cortical areas are not sharply demarcated circles, like those



e. Same on mesal face.

drawn on Ferrier's diagrams, or on the older phrenological charts, but diffuse areas and rather districts of functional concentration, and that they overlap each other, we can understand why even a considerable lesion may fail to destroy a given function permanently. It remains, however, a fact, that considerable lesions in the areas of greatest functional intensity are never followed by complete recovery. From this point of view the various hypotheses of Hughlings, Jackson and others, however ingenious they may be as theories, fall to the ground and become, to say the very least, superfluous.

After the announcement of these conclusions, the abstracts of one hundred and sixty-seven cases are given. Among those from whom these cases are cited, Bramwell, Charcot-Pitres, Furstner, Petrina, Nothnagel, Boyer, and Bourneville are notable for the large number of cases contributed by them to this list. A full and comprehensive literature of the whole subject concludes the volume, which is rendered one of the most attractive contributions to our modern physiological literature, by the addition of twenty-five excellent plates, many of which are colored, while others contain photographs.

There is but a single point which the author seems to us to have laid insufficient stress on, and which yet might have furnished many interesting suggestions in support of the kind of localization which he appears to us to have established. We refer to the wonderful correspondence between his areas and the areas of particular types of cortical structure. Thus the visual area corresponds in its distribution to the area in which Meynert describes his eight-layered cortical type to occur in the greatest purity. The diffusion of the motor centers appears to harmonize with the discovery of cortical nests of large pyramids outside of the area where Betz first located them. The identity in locality of tactile with motor areas harmonizes with the notorious coincidence of a granular cortical layer, suspected to be sensory by Meynert, with the largest presumably motor pyramids in the fourth layer of the five-layered cortical type. There are other views of Meynert which acquire a strong support from Exner's researches; aside from the confirmation of Meynert's visual area, the latter's "speech field" is not only re-established but extended by the cautious compiler and critic whose valuable monograph we regret not having the space to present to our readers in a fuller abstract.

#### BOOKS RECEIVED.

**VOLCANOES: WHAT THEY ARE AND WHAT THEY TEACH.** By JOHN W. JUDD, F. R. S. Appleton & Co., New York.

"Vulcanologists have only just commenced those series of exact and continuous observations which are necessary to determine the conditions that regulate the appearance of volcanic phenomena. The study of the laws of volcanic action is yet in its infancy."

This astonishing and undeniable statement concerning a class of magnificent phenomena which have excited the admiration and awe, and been interwoven with the religious hopes and fears of the most intelligent portion of our race from the beginning of time, is a revelation of the inchoate state of natural science, notwithstanding its boasted progress in certain narrow fields. Every step in the modern search and study of distant worlds has been gained in large part by the invention and application of some new instrument, such as the telescope and spectroscopy; and, in the same way, this new book on a very ancient subject, presents to us a similar anomaly in that one of the most efficient means for peering into the abysses of our own globe has been found in the use of the microscope. The merits of this excellent work must be obvious to the most cursory reader, so far at least as regards the fascinating nature of the subject, the clear and easy style, the avoidance of technical terms, and the use of familiar illustrations, wisely chosen in the main from a few historical and most thoroughly studied volcanic vents. To the expert as well, even in so limited and popular a condensation of the bulky literature of the subject, pleasure

will be imparted by the careful classification and in general correct exposition of the principal facts and generalizations thus far gathered, by the avoidance of dogmatic over-statement (e. g., of invariability of the order of eruption of lavas, pp. 198-200)—by the simplification of the relationship and nomenclature of rocks (e. g., Chapter ix, pp. 247-269, etc.), in quiet protest against the minute sub-divisions of the laboratory-lithologists of Great Britain, and especially of Germany,—and by the prudent brevity and caution with which the more difficult, and indeed as yet inscrutable, themes of the last two chapters are discussed. The attention of American geologists might be particularly invited to the consideration of the evidences (pp. 240-242, etc.) of the sub-aerial and explosive character of probably nearly all the trap-overflows on this continent, now often regarded as quiet submarine or sub-terrestrial injections; and the time is soon coming for the recognition of the true nature of enormous accumulations of aerial volcanic deposits, tuffs, lapilli, etc., *in almost every part of our continent*, in spite of their long disguise through metamorphism and consolidation.

There are certain distinctions of importance made by the author, however, with which many students of petrography, both in this country and abroad, will not agree. One of these is the unguarded definition of granite, gabbro, diorite, etc., as merely conditions of lava, "crystalline varieties in masses which have cooled slowly at great depths" (pp. 58, 260, 265, 322, etc.). That may be true in many instances, especially at the British localities, with which the author is most familiar, e. g., the Volcano of Mull (p. 142). The popular student should, however, be advised that the same rocks abundantly occur elsewhere, particularly in that part of our continent which lies east of the Mississippi, in forms which are very similar to these, but not at all to be confounded with lavas, their derivation being entirely and unmistakably from the metamorphism of sediments: e. g., the granitoid gneisses, gabbro-gneisses, and metamorphic diorites and diabases of the Eastern United States.

Again, the origin of the "red clay" which is found to cover the bottom of the ocean over its abyssal areas can be only in part assigned to the cause accepted by the author, the disintegration of volcanic dust and oxidation of their content of magnetite (p. 74); the studies of Thomson, Nelson, Buchanan and others have shown the high probability of its partial increment as an insoluble residue from the solvent action of the carbon dioxide in seawater upon the calcareous globigerina-ooze, etc.

The origin of the interesting filamentous variety of volcanic glass of the crater of Kilauea in Hawaii, called "Pélé's Hair," which is apparently attributed to the upward impulsion of particles of liquid glass into the air by the passage of steam (p. 71), is explained with more probability by Dana, through the conveyance and drawing out of such particles by the winds.

It is true that fine crystals and concretions of minerals of certain groups, especially leucite, the zeolites, agate, etc., owe their origin in general, directly or indirectly, to volcanic action (p. 148-9), but the most ardent Huttonian must confess that there is no prevailing connection between "great masses of fused volcanic rock" and the sediments which now enclose "diamonds, rubies, sapphires, emeralds, topazes, garnets," etc.: the list is characteristic of metamorphic strata, and the author has evidently pressed his point too far.

Exception may well be taken also to the little attention paid by the author to the remarkable volcanic chain in the West India islands, still comprising six active vents (p. 228), notwithstanding his recognition of the significant fact of the vast depths in the neighboring portion of the Atlantic, ascertained by the deep-sea soundings of the Challenger (p. 242). In very opposition to this fact and disregard of its meaning, he considers this volcanic group merely as a secondary branching chain of minor importance (p. 233), connecting the great band of volcanoes of



the western border of the American continent with that which traverses the Atlantic and properly pertaining to the latter band (pp. 228-235). A better acquaintance with the volcanic vents, active and extinct, both of the West Indies and of the eastern border of the American continents will find in these a fifth band, additional to the four enumerated (pp. 228-235), marked by the Alleghany axis along the eastern border of North America and that of the Highlands of Guiana and Brazil, in South America; while the sharply defined intermediate chain, traversing the great subsided continent which lies beneath the Caribbean sea, still retains a few active vents. May their present partial activity be an indication of the commencement of an era of renewed elevation over that now deeply sunken area?

The work presents also a few minor blemishes which might be easily corrected in another edition. Only in the vague phrase—"a high power of the microscope," (p. 53)—can the reader, unfamiliar with the subject, find a clue to the magnification employed in those figures of the frontispiece representing the excessively minute structures found in the vitreous and crypto-crystalline rocks. The same objection applies to the figures and descriptions of the minute liquid cavities detected in the crystals of rocks (fig. 7, p. 61). In one figure, part of the reference letters have been obliterated (fig. 36, p. 118). The desire to avoid the appearance of a text-book has led to the omission of all sub-divisions of the text, such as headings or marginal references, within the twelve chapters: the consequence has been a series of apparently abrupt and even violent changes of the subject without assistance to the eye, which at first produces a rather puzzling impression on one's succession of thought, and, without resort to the index—which is excellent—renders difficult a later reference or return to any desired paragraph. The wood cuts are abundant, well chosen, and in general so well executed as to render the coarseness of one of the full page illustrations (fig. 41) somewhat unpleasant to the eye. May not even the scientist, the vulcanologist, be an aesthete? May not even his hard trappan intellect crave, beyond the dry facts shown in this rough sketch the finer lines which may suggest the balmy atmosphere which rests over this isle in the Mediterranean, the tender green upon its hillsides, the delicious blue of the heavens above and of the waters beneath?

But perhaps the most serious defect of the book, at least for American readers, for whose benefit this volume of "The International Scientific Series" has been largely prepared, lies in the almost entire absence of illustrations, either in the text or figures, taken from the volcanic localities on this continent, whose descriptions now abound in all the current literature, ready to Prof. Judd's hands. Derision is well expressed in Chapter I, at the absurd views prevalent not only among the ancients but in modern school manuals, concerning the nature of volcanoes. But here is a new book, just issued by an American publishing house, to teach the American public "what a volcano is," with an almost complete disregard of the volcanic materials, upon and into and among which American feet and hands are walking and digging and climbing every day! It was well to give prominence to the work of Scrope, Hamilton, Möhl, and, above all, Palmieri, and the excellent Italian school of vulcanologists, but the value of such a book, for popular and "International" purposes, would have been largely augmented by less meagre references to the grand instances of volcanic outbursts in this hemisphere, whose descriptions we owe to the laborious study of Dana, Newberry, Hayden, Gilbert, Endlich, Dutton, and many others. The little hills of England, Wales and Scotland afford excellent illustrations of extinct volcanic vents for the British public; but why, O why, should not discreet reference be vouchsafed to transatlantic localities for the benefit of Prof. Judd's thirty odd millions of

cousins? For example, for volcanic activity in Cambro-Silurian times (p. 274), to the vast outflows on the present borders of Lake Superior: for its cessation in this hemisphere during a vast subsequent period, to the scarcity or entire absence of such outflows in all our Devonian and Carboniferous basins: and for its resumption here, during the repose of the European vents, to the enormous eruptions of trap through the Triassic beds along the whole Atlantic seaboard, and, still later, throughout the Western Cretaceous plateaus.

It is shown (p. 227), and will doubtless prove a surprise to many an American reader, that "the American Continent contains a greater number of volcanoes than the divisions of the Old World. There are twenty in North America, twenty-five in Central America, and thirty-seven in South America," *i. e.*, eighty-two great volcanic vents in action on our continents, to only thirty-five in Europe, Asia and Africa. But, more than this, the same great band "contains, with its branches, nearly a hundred active volcanoes," and this fact, taken in connection with the vast volcanic outflows from ancient vents which overspread the Western plateaus, indicates that America is the grandest field in the world for the study of volcanic phenomena; and this little book, excellent as it is, with the limited field of observation from which it has been mainly written, gives a suggestion of the magnificent monograph on this subject which is yet to come from some American hand.

ALEXIS A. JULIEN.

## THE GREAT PRIMORDIAL FORCE.

BY DR. H. RAYMOND ROGERS.

*Continued.*

The existence of other affections of the primordial force, in addition to those already recognized as the "Great Physical Forces," has been more than suspected by distinguished scientists. HUMBOLDT pertinently asks: "who will venture to affirm that we have discovered the whole number of forces which pervade the universe?"

Among the non-recognized affections which are legitimately entitled to a position in that category, we now take the liberty of including

### WIND.

According to present conceptions and teachings concerning the *modus operandi* of wind-production, wind is due to the creation by the sun's heat of a warm, light atmosphere, or rarified atmosphere which rises, the colder surrounding air rushing in from all sides to restore the equilibrium. The equatorial regions, being most highly heated, are the grand theatre of this complex movement. The equatorial air rising, the air both north and south moves forward to make good the deficiency. This new air, in its turn is heated and rises, and thus a constant upward current is established, and at the same time two opposite lateral surface currents. Add now to this movement the motion of the earth on its axis to modify these lateral currents and we have the great aerial currents as now existing, as for example, the trade-winds. Periodical and occasional storms originate in differences of temperature produced likewise by the sun's heat, which causes a movement for the restoration of a disturbed equilibrium. The regular or prevailing winds of our temperate zone are produced by the meeting of equatorial and polar currents.

Such is the main theory. But yet in explaining the details of the theory there is such a lack of unanimity as to render the whole theory doubtful. The rotary theory of DOVE, the centripetal, or in-blowing theory of ESPY, and the theory of BLASIUS which antagonizes both, evince the existing uncertainty and dissatisfaction. If we allow BLASIUS to begin a storm, REDFIELD to manage the middle of it, and ESPY to finish it up, we may get a plausible theory.

However, upon thoughtful consideration, there are

found to be too much variety, too much system and regularity, also too much *irregularity*, in these mysterious aerial phenomena, to be lightly explained by causes which are *only sufficient to account for a confused commotion of the atmosphere*. The orderly system of winds, the variety of their movements,—such as the shaking of a solitary leaf here and there; the liliputian dust whirlwind seen upon our streets; fitful gusts and squalls; intermittent pauses and blasts in storms of all kinds; the pillar of fire that sometimes constitutes the whirlwind; and the terrific outbursts and violence of the tornado;—these point to some productive agent, or agents, other than such as are only competent to create a mere stir and confusion of the aerial elements.

Now, supposing the winds to be due to the operation of the presumed calorific and axial agencies aforesaid,—is it not a difficult thing to explain why there should not be precisely the same and equivalent aerial effects day after day, in a never ceasing repetition? Causes remaining the same, effects could not be so very different. One day is calm and quiet, while the next is exceedingly windy. Yet meanwhile, sun and earth are in unaltered relations to one another, the sun's rays rarifying the atmosphere and the earth steadily revolving on both days alike. Endless phenomenal movements are left unaccounted for. We understand of course that commendable attempts have been made to explain such changes and yet ample room is left for a more self-demonstrating hypothesis.

Even granting that the sun's heat is the *primum mobile* of winds and storms, it is reasonable to suppose that their movements would be exceedingly slow and destitute of regular and well defined boundaries. Method in their action would be wanting, or else it would be a different method from that which is observed. Thus, whirlwinds and devastating tornadoes, often, and indeed generally, arise out of perfect calmness, and leap forth into hurricane velocity. In order to explain them it is affirmed that contrary winds of different temperatures, meeting, "*bank up* against each other," and push like two great wrestlers, and there, piling up more and more, they stand with ominous quiet until, by reason of hill or depression in the configuration of the given region one gains the ascendancy and then they enter into a whirling conflict with devastating fury. It reminds us of Virgil's representation of old Æolus letting out the winds from his cave, and the difficulty with which they were brought into confinement again. The objection to such explanation is that they are not only purely hypothetical, but also lack support of analogy to anything else. The explanation itself even more loudly calls for explanation than the original phenomenon explained.

We therefore hold that wind phenomena are yet inadequately interpreted. Calorific force is owing to the immediate action of the sun; yet in the polar regions, from which the sun is for half the year absent, and where, during that period, the temperature is far below zero, wind prevails in its fiercest forms. We must here exclude calorific influences from our reckoning. During this self-same period, in the equatorial region, the sun is at its greatest altitude, and transmits its beams almost vertically through the deepest, densest atmospheric mass, whereby its calorific effect reaches its maximum; yet, notwithstanding these most favorable conditions for the development of wind in the tropical belt, wind prevails in the *sunless* polar regions with a greater *constancy* and *force* even, than in the equatorial.

The theory that the earth in its axial motions is capable of developing wind is destitute of rational support. There is but slight evidence of such result in the region where such motion, if it existed, would find its greatest velocity, viz: at the equator. Between the two trade-winds are the zones, significantly termed the *Zones of Calms*. In these zones the waters appear like a vast sheet of ice, and a ship therein appears as if nailed to the limpid crystals, while the solar rays fall vertically upon the deck. Within

these zones no atmospheric currents have ever been discovered which could be rationally attributed to such axial motion of the earth. In fact the equatorial belt is confessedly most exempt from *steady, forceful* winds; and there is no record of a hurricane having been encountered on the equator. Calorific influence and axial motion therefore most signally fail to account for the production of wind.

In studying the inherent character and mode of action of this formidable force it becomes indispensable to seek out a philosophy which shall not only demonstrate a cause commensurate with the vastness of its field and its power, but also one which shall be consistent with its varied phenomena. Such a philosophy must conform to the requirements of the law of conservation of force. We must possess a correct knowledge of the ingredients of which the atmosphere—the field of its operations—is composed, and also of the relations between it, and the earth upon which it is superimposed. One ingredient has heretofore been wholly ignored as a real entity. All theories afore-mentioned disregard this ingredient, through which alone may be explained the wind's vast and varied phenomena. This ingredient is magnetic.

That the atmosphere is a vast magnetic reservoir, that it is one of the most magnetic of earthly bodies is well understood. That the earth is also such a reservoir of magnetic force, and that reciprocal and instantaneous action takes place between the atmosphere and the earth through the medium of the magnetic constituent, is also well understood, yet no effort has been made to utilize the knowledge of such intimate relationship and sympathy in the construction of the theories of the wind.

The great earth-core with its 250,000,000,000 of cubic miles of matter to a quarter or less extent and degree incandescent, may be presumed to exercise functions of which little account has heretofore been made. These functions must necessarily be commensurate with its stupendous mass. In the retro-acting phenomena which are manifested between the sun and earth we may justly attribute to this mass a co-operation in the production of the grandest of terrestrial effects, viz: the greater physical forces; among these effects we may class wind.

Sudden sun-bursts produce instantaneous magnetic effects throughout the earth. Magnetic storms simultaneously disturb the needles over an area nearly or quite equal to the terrestrial surface, and lesser areas are being incessantly disturbed. Thus terrestrial magnetic action is constantly taking place. The atmospheric magnetism being in closest sympathy and in fixed and exact relations with the terrestrial, must be influenced by it.

The *a priori* conclusions of the old theories are strangely negated by constantly observed facts. Thus, strong gales are seen to leap out of perfect calmness into hurricane velocity, and afterwards to cease as suddenly as though stopped by the interposition of some mighty invisible wall. Tornadoes mow their swaths through forests and villages scarcely rippling the neighboring air or disturbing the adjacent territory or its belongings. There are observed to be, transverse and opposite currents moving simultaneously, at varying rates of speed, some slow, some exceedingly swift. Indeed the entire atmosphere, to the altitude of many thousand feet, is constantly traversed by horizontal currents of air, flowing in different directions, and at different elevations. An aeronaut at the elevation of 14000 feet encountered a current that carried him at the rate of five miles per hour, but upon descending only 2000 feet he met a contrary wind blowing with a velocity of eighty miles per hour. The common old theory certainly leaves all these phenomena unexplained. Calorific influences may have granted to them a generous allowance of efficiency, but no man can see *how* they are able to explain such results as we have recounted. It is a purely mechanical theory. It presupposes the atmosphere to be only a loose mixture of gaseous materials, and the winds to be owing only to mechanical disturbances

within it. It is not easy to see how a *law* of the winds can be deduced from such a theory. Such a theory of the winds misses its real intimate nature, and is insufficient. But once conceive the atmosphere as arranged like a perfectly adjusted instrument for the meeting-place and co-operation of sun-force, and earth-force, where are elaborated all the benefits designed for our mundane creation, and we begin to look for better explanations.

From necessity, our philosophers have been compelled to acknowledge that *certain* of these phenomena exhibit signs of an electric origin. Certainly they were accompanied by electrical effects. It is granted that there are established electric currents in the atmosphere and within the earth itself. The magnetic poles are facts that no one thinks of gainsaying. The reservoirs of electricity are at hand to be made use of; and it is known that to them belongs a range of activities within the great economy of the earth. Have we not reason to believe that the winds are intimately associated with this electric force? Why should the two be divorced in our philosophy and in our science? Why should it be hought incredible that we are on the eve of better explanations of the wind?

The wind is moving air—this will answer for a rough definition, where only effects and not causes are considered. *The wind is the electric force operating on, and within the air, variously in different parts and portions of the air*—this may be called a definition which considers causes as well as effects. FARADAY says that “the earth is itself a magnet, pervaded in every part by this mighty power” [magnetism]; and he supposes that it has a purpose. The earth has its magnetic polarity. To its magnetism certain electrical currents are related. Between the magnetic earth and the enveloping magnetic atmosphere and its magnetic clouds there is an electrical commerce and interplay. The law of a necessary equilibrium is proclaimed by every thunder-storm, by every shaft of lightning that visits the earth. Does not the same force find in the air one of its chief agents? Who can doubt it? We cannot then be far out of the way when we say that *in the interplay of that subtle, all-pervasive principle is found the key to the theory of the winds*.

Thus in viewing the earth and atmosphere as vast reservoirs of that subtle principle, shifting back and forth to maintain an equilibrium, we believe that we are enabled to see the workings of the very force which moves and sways the atmosphere; which causes its currents both general and special, and which gives rise to its more extraordinary and yet unexplained phenomena. It is not excessive boldness on our part to affirm that never as yet has due attention been paid to the electrical changes in the conditions of the earth, and of the atmosphere—and, as scientists are beginning to suspect—of the sun also.

It is known that electricity moves with difficulty through air. It may far more easily be the cause of movement of the body of the air, of which it is itself a vital constituent. By virtue of the associated electricity in each—one body of air, or one stratum of air is attracted towards another, or repelled from another, or otherwise influenced, according to the law that likes repel and unlikes attract. But, besides the mutual influence of electrified bodies and strata of air upon one another, there is the controlling influence of the established electric or magnetic currents upon these electrified bodies and strata; and the controlling influence of the magnetic earth itself, and her hidden currents. Such are certain necessary elements in the problem of the wind, that scientists may not leave out of their reckoning.

In support of the electrical hypothesis we have the influence of high authorities, and the demonstration of constantly observed facts. FLAMMARION, in speaking of the whirlwind, says: “we know that a whirlwind is a column of air which turns upon its own axis, and which advances comparatively slowly. This whirling column

of air is both caused and set in motion by electricity.” PELTIER has established both by numerous facts and by a series of experiments, that the waterspouts of the land and sea are electrical phenomena.

This had been suspected by BECCARIA a hundred years before.

If whirlwinds (and waterspouts) are caused by electricity, why may not all other forms of wind be products of the same force?

FLAMMARION also says: “generally speaking, the action of electricity is superadded to the violence of the air in motion, and helps to augment the ravages of the tempest: sometimes flashes of lightning are so rapid that they descend like a sheet of flames; the clouds, and even the drops of rain, emit light. A whole forest in the island of St. Vincent was killed without the trunk of a single tree being blown down. In Europe, too, upon the shores of Lake Constance, many trees were skinned of their bark, though they still remained upright in the ground.”

HUMBOLDT thus aptly says: “the electricity of the atmosphere, whether considered in the lower or upper strata of clouds—in its silent, problematical, diurnal course, or in the explosion of the lightning and thunder of the tempest—appears to stand in a manifold relation to all phenomena of the distribution of heat, of the pressure of the atmosphere and its disturbances, of hydro-meteoric exhibitions, and probably also of the magnetism of the external crust of the earth.”

From the great number of authentic facts which demonstrate the electrical character of the winds, we select the following:

The hurricane which occurred in the Barbadoes in 1831, was the most remarkable on record. The lightning for hours played in forked darts, and moved frightfully between the clouds and the earth. The moment this singular alternation of the lightning passing to and fro, ceased, the hurricane burst with a violence which exceeded all which had yet been experienced. The winds blew with appalling velocity, and changed their course frequently and almost instantaneously, occasionally abating but only to return in gusts from S. W.—W. and N. W. with accumulated fury. These alternations of wind and violent electrical demonstrations were something more than coincident, more than a casual connection; herein we observe a manifest inter-dependence.

A remarkable phenomenon was exhibited by a hurricane at sea in 1837, and described by CAPT. SEYMOUR, of Cork: “for an hour we could not see each other nor anything else but merely the light, and more astonishing, every one of our finger-nails turned quite black, and remained so for nearly five weeks afterwards. This fact,” says CAPT. S., “may be classed among the proofs of the agency of electricity in the production of hurricanes.”

On the 26th of August, 1826, the neighborhood of Carcassonne was visited by an enormous column of fire which, sweeping along the surface of the soil, destroyed everything that lay in its passage.

In the whirlwind that devastated Chatenay in 1839 the trees that lay within its circumference were burned up. In fact, trees were found with the side which had been exposed to the storm completely scorched and burned, whereas the opposite side remained green and fresh.

During a whirlwind which occurred in the plain of Assonville, July, 1822, the rapidly revolving cone, as it rose, emitted a sound like that caused by the bursting of a large shell, leaving an indentation upon the ground twenty-five or thirty feet in circumference and to a depth of three or four feet in the middle. Globes of sulphurous vapor were from time to time emitted, and the noise which was made was like that of a heavy carriage driven rapidly over paving-stones. Each time that a globe of fire or vapor was emitted there was an explosion like that of a gun.

The foregoing phenomena of the wind could under

no circumstances or conditions be produced by calorific influence.

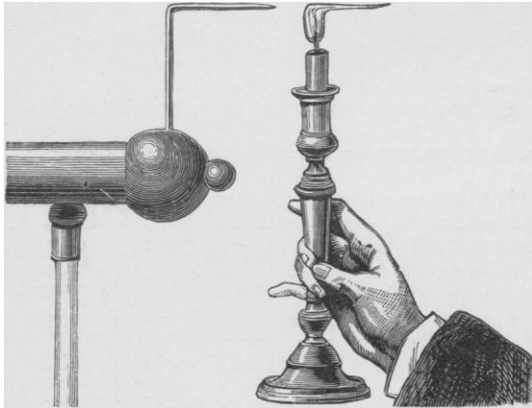


PLATE.

If a metallic rod terminating in a point be attached to the conductor of an electrical machine, electricity escapes in large quantities from the point. A continuous current is thus kept up and the flame of a taper, if placed in front of the current, is blown in a horizontal direction. If the point be removed from the conductor, a current of wind issuing from the conductor may be felt by the hand. Wind is thus *manufactured* on a small scale.

The ancient vague presentiment of electric and mag-

netic action is verified in our times. KUOPHO, a Chinese physicist of the third century, says: "the magnet attracts iron as amber does the smallest grain of mustard seed. It is like a *breath of wind* which mysteriously penetrates through both and communicates itself with the rapidity of an arrow."

We have seen the marks of electrical action in the cases cited, and since we know something of the subtlety of the agent—that it may be "amassed, condensed, and rarified," that it is not loose and wandering, and the mere plaything of fortuitous forces, as the atmosphere is supposed to be, but, on the contrary, has close and most sympathetic adjustment with the earth-force; and that it is the invisible hand that holds and manages the grosser atmospheric matters;—since we know this, we are now brought to the study of a great cosmical system.

NICKEL ELECTROTYPES.—Notwithstanding the ease with which nickel is deposited now-a-days, it has required years of careful work to learn how to deposit a sufficiently thick and solid layer of nickel on wax or gutta-percha impressions. The *Revue Industrielle* says that the difficulties have now been successfully overcome, as the nickel electrotypes shown at the recent Paris Electrical Exhibition prove. Although costing double the price of copper electrotypes those made of nickel have the advantages of allowing a much greater number of impressions to be made, of not being so easily injured by oxidation, and of permitting colored inks which attack copper to be used.

#### METEOROLOGICAL REPORT FOR NEW YORK CITY FOR THE WEEK ENDING DEC. 10, 1881.

Latitude 40° 45' 58" N.; Longitude 73° 57' 58" W.; height of instruments above the ground, 53 feet; above the sea, 97 feet; by self-recording instruments.

| BAROMETER.     |                      |       |                      |          |                      | THERMOMETERS. |           |           |           |           |           |           |           |           |        |
|----------------|----------------------|-------|----------------------|----------|----------------------|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--------|
| DECEMBER.      | MEAN FOR THE DAY.    |       | MAXIMUM.             |          | MINIMUM.             |               | MEAN.     |           | MAXIMUM.  |           | MINIMUM.  |           |           |           | MAXI'M |
|                | Reduced to Freezing. | Time. | Reduced to Freezing. | Time.    | Reduced to Freezing. | Time.         | Dry Bulb. | Wet Bulb. | Dry Bulb. | Wet Bulb. | Dry Bulb. | Wet Bulb. | Dry Bulb. | Wet Bulb. | In Sun |
| Sunday, 4--    | 30.109               |       | 30.148               | 12 p. m. | 30.078               | 1 p. m.       | 37.6      | 37.0      | 39        | 1 p. m.   | 38        | 1 p. m.   | 35        | 3 p. m.   | 47.    |
| Monday, 5--    | 30.200               |       | 30.208               | 9 p. m.  | 30.148               | 0 a. m.       | 39.0      | 36.6      | 43        | 2 p. m.   | 39        | 2 p. m.   | 35        | 12 p. m.  | 100.   |
| Tuesday, 6--   | 29.986               |       | 30.172               | 0 a. m.  | 29.712               | 12 p. m.      | 39.3      | 37.0      | 44        | 3 p. m.   | 40        | 3 p. m.   | 32        | 7 a. m.   | 74.    |
| Wednesday, 7-- | 29.485               |       | 29.712               | 0 a. m.  | 29.410               | 2 p. m.       | 41.0      | 38.3      | 44        | 3 a. m.   | 41        | 3 a. m.   | 35        | 12 p. m.  | 52.    |
| Thursday, 8--  | 29.855               |       | 29.958               | 12 p. m. | 29.578               | 0 a. m.       | 33.3      | 31.0      | 37        | 3 p. m.   | 33        | 0 a. m.   | 30        | 9 a. m.   | 94.    |
| Friday, 9--    | 29.981               |       | 30.008               | 12 p. m. | 29.950               | 5 a. m.       | 37.7      | 35.0      | 43        | 2 p. m.   | 38        | 2 p. m.   | 32        | 7 a. m.   | 95.    |
| Saturday, 10-- | 30.193               |       | 30.362               | 12 p. m. | 30.008               | 0 a. m.       | 28.6      | 27.7      | 38        | 0 a. m.   | 35        | 0 a. m.   | 22        | 12 p. m.  | 96.    |

|                                                  |                |                                         |              |                    |               |
|--------------------------------------------------|----------------|-----------------------------------------|--------------|--------------------|---------------|
| Mean for the week.....                           | 29.972 inches. | Mean for the week.....                  | 36.6 degrees | Dry.               | Wet.          |
| Maximum for the week at 12 p. m., Dec. 10th..... | 30.362 "       | Maximum for the week at 3 pm., 6th..... | 44.          | at 3 am 7th, 41.   | 34.6 degrees. |
| Minimum " at 2 p. m., Dec. 7th.....              | 29.410 "       | Minimum " " 12 pm., 10th.....           | 22.          | at 12 pm 10th, 22. | "             |
| Range.....                                       | .952 "         | Range " ".....                          | 22.          | "                  | 19.           |

| WIND.      |            |          |          |                             |                                    |        | HYGROMETER.     |         |         |                       |         |         | CLOUDS.             |            |            | RAIN AND SNOW.                       |                         |                         |                    | OZONE. |     |
|------------|------------|----------|----------|-----------------------------|------------------------------------|--------|-----------------|---------|---------|-----------------------|---------|---------|---------------------|------------|------------|--------------------------------------|-------------------------|-------------------------|--------------------|--------|-----|
| DECEMBER.  | DIRECTION. |          |          | VELOCITY<br>IN MILES.       | FORCE IN<br>LBS. PER<br>SQR. FEET. |        | FORCE OF VAPOR. |         |         | RELATIVE<br>HUMIDITY. |         |         | CLEAR,<br>OVERCAST. |            |            | DEPTH OF RAIN AND SNOW<br>IN INCHES. |                         |                         |                    |        |     |
|            | 7 a. m.    | 2 p. m.  | o p. m.  | Distance<br>for the<br>Day. | Max.                               | Time.  | 7 a. m.         | 2 p. m. | 9 p. m. | 7 a. m.               | 2 p. m. | 9 p. m. | 7 a. m.             | 2 p. m.    | 9 p. m.    | Time of<br>Begin-<br>ning.           | Time of<br>End-<br>ing. | Dura-<br>tion.<br>h. m. | Amount<br>of water |        |     |
| Sunday,    | 4.         | n. n. e. | n. n. e. | n. e.                       | 198                                | 3 1/2  | 3.30 pm         | .199    | .229    | .207                  | 90      | 100     | 90                  | 10         | 0          | 0                                    | 0                       | am                      | 6 pm               | 18.00  | .50 |
| Monday,    | 5.         | n. e.    | e.       | n.                          | 170                                | 3 1/2  | 5.50 am         | .191    | .186    | .186                  | 90      | 67      | 81                  | 4 cir. cu. | 1 cu. s.   | 0                                    | 0                       | ----                    | ----               | ----   | 7   |
| Tuesday,   | 6.         | n.       | s. s. w. | s.                          | 87                                 | 3      | 5.30 pm         | .181    | .186    | .208                  | 100     | 67      | 75                  | 3 cir. s.  | 7 cir. cu. | 8 cu.                                | 0                       | ----                    | ----               | ----   | 1   |
| Wednesday, | 7.         | s. w.    | w. n. w. | w. n. w.                    | 286                                | 12 1/2 | 11.15 pm        | .221    | .231    | .144                  | 83      | 83      | 63                  | 10         | 9 cu.      | 1 cir. s.                            | 0                       | 4 am                    | 10 am              | 6.00   | .19 |
| Thursday,  | 8.         | n. w.    | w. n. w. | w.                          | 364                                | 17     | 0.40 am         | .149    | .129    | .155                  | 89      | 61      | 79                  | 0          | 1 s.       | 3 cir.                               | 0                       | 1 pm                    | 1.30 pm            | 0.30   | .01 |
| Friday,    | 9.         | w. s. w. | w.       | w. n. w.                    | 182                                | 3      | 7.00 am         | .162    | .164    | .186                  | 89      | 59      | 81                  | 7 cir. cu. | 9 cu. s.   | 4 cir. cu.                           | 0                       | ----                    | ----               | ----   | 0   |
| Saturday,  | 10.        | n.       | n. n. w. | n. n. w.                    | 226                                | 9      | 1.50 pm         | .174    | .119    | .129                  | 100     | 68      | 100                 | 8 cu.      | 2 cir. s.  | 0                                    | 0                       | ----                    | ----               | ----   | 8   |

Distance traveled during the week..... 1,513 miles. Total amount of water for the week..... .70 inch.  
Maximum force.. 17 lbs. Duration of rain..... 1 day, 30 minutes.

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